

## WILLOWS OF THE ROCKY MOUNTAIN STATES

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About two-thirds of all willow (*Salix*) species occurring in the United States outside Alaska are found in the Rocky Mountain states. Treatments of the genus in state floras of this region are out-of-date and most contain significant errors. I recently completed a detailed study of one section of the genus (Dorn, 1975a), and during that study much data were obtained on other sections. Since it may be a considerable period before all the sections can be studied in detail, it is desirable to bring the taxonomy of Rocky Mountain willows up to date at this time and to point out the more important problems still remaining.

I have spent the last nine summers observing willows in the field from Alaska to Newfoundland south to California, Colorado, and Massachusetts. I have not had the opportunity for field study in much of California and the Southwest. Southwestern willows are included here because these species have diverged from each other more than those in most other areas and, thus, are easier to treat taxonomically.

This study is based on specimens in A, ARIZ, CAN, CS, DAO, F, GH, JEPS, K, MONT, MONTU, NA, NY, PH, RM, SASK, UC, and US (abbreviations follow Holmgren & Keuken, 1974). I have seen all the original descriptions, but I have not seen all the type specimens. The location of some types is still uncertain. Some early workers studied specimens in private and public herbaria all over Europe and based their descriptions of new species on some of these. Thus, locating a type specimen and designating lectotypes often require detailed study. Herbaria listed here are only for those types actually seen or for those with a reliable reference in the literature. Most species synonyms with type localities in the Rocky Mountain states are listed. Only a few of the many proposed infraspecific names are included. An evaluation of most of these must await further study. A number of chromosome counts were obtained, and these were reported elsewhere (Dorn, 1975a, 1975b, 1976). Moreover, the flavonoid chemistry of the leaves of many species was surveyed. Flavonoid profiles alone are of limited taxonomic value, as there may be more than one profile within a single apparent species, or different species may have the same profile and



the compounds may or may not be the same. Compounds were identified for eleven of the species (Dorn, 1975a; Argus, unpublished data). These data are most useful when used in conjunction with other data.

#### TERMINOLOGY

The terminology for *Salix* used here generally follows Argus (1973). Some of the terms, however, need elaboration. *Pruinose* refers to a bluish-white bloom on the branches which is rubbed off easily. *Glaucous* refers to a whitish wax on the underside of leaves which also can be rubbed off. This characteristic often appears granular under high magnification. Leaves of some species are merely pale beneath but lack the whitish wax. A *floriferous* branchlet is a branchlet which bears flowers. Its length is measured from its growing point of the season to the lowermost flower bract (which may actually lack a flower). This is equivalent to the term peduncle of many authors. *Bract* refers to the foliar structure (seldom green) subtending each flower. Some authors use the term scale for this structure. The *stipe* is the stalk of the pistil. *Pedicel* is the older, equivalent term.

#### MORPHOLOGY

There appear to be exceptions to the usual situation in all morphological characteristics, at least when considering the genus as a whole. Some characteristics are much more constant than others, and some that are constant in one section may be variable in another. This has been a source of much confusion in the past.

In the Rocky Mountain states, the distinction of the two subgenera, *Salix* and *Vetrix*, is very sharp if persistence of the fruiting bracts is employed. In the primitive subg. *Salix*, the species have deciduous fruiting bracts while in subg. *Vetrix* the fruiting bracts are persistent. The native sections of subg. *Salix* are also easily separated. The species of sect. *Humboldtianae* have the unique feature of bud scales with free overlapping margins. In other sections the margins are fused to form a cap-like bud scale. Species of sect. *Salicaster* have mostly lanceolate to ovate leaves and three or more stamens, while those of sect. *Longifoliae* have two stamens and predominantly linear leaves. Species of sect. *Salix* are introduced trees with mostly lanceolate or lance-linear leaves and mostly two stamens.



The sections of the more advanced subg. *Vetrix* are not so easily separable. The most constant characteristics are leaf glaucescence and capsule pubescence, but these cut across sectional lines. Number and position of nectaries and presence or absence of stomata on the upper leaf surface, characteristics that were frequently used by Schneider (1921), have a relatively poor constancy. Leaf shape and size, often used by Ball (1952), are also not very constant. Some characteristics are often quite constant but are difficult to describe. These include the degree and pattern of cracking or furrowing of the bark of older branches (often lacking on herbarium specimens), leaf color and texture, and venation pattern in leaves.

#### TAXONOMY

Keys to staminate and vegetative material are extremely difficult to construct for more than about 20 species, or fewer when they are closely related. The best way to identify staminate material is to compare it (flower bracts, leaves, branchlets, buds) with pistillate material collected from the same area. Ideally, both staminate and pistillate plants should be tagged and mature leaves collected later, particularly for species with precocious aments. Sequential collections from the same plant are always easier to identify. When collecting specimens, it is desirable to obtain growth three or four years old. Important data to record are height, habitat, elevation, and presence or absence of glaucescence on the underside of the leaves at time of collection. It is desirable to note associated *Salix* species in case a question of hybridization arises. However, hybridization is extremely difficult to prove in wild individuals, and it is certainly uncommon in the Rocky Mountain states. Flavonoid chemistry studies have shown that suspected hybrids based on morphological characteristics were simply morphological variants of a single species (Dorn, 1975a).

Due to the great morphological variability of willows, it is not practical to take into account all of the exceptions when constructing a key for identification. If they were taken into account, we would have a series of contrasting descriptions. A compromise attempts to maximize correct determinations while avoiding undue length and complexity. A correct determination can be expected over 95 percent of the time with the pistillate key if good, mature specimens are available. The percentage will be lower with the staminate key.



The sectional classification follows my synopsis of American willows (Dorn, 1976). Additional discussion and references appear in that paper. The area included in this treatment covers the states of Idaho, Montana, Wyoming, Colorado, Utah, Nevada, Arizona, and New Mexico and the Black Hills area of South Dakota. In most cases, descriptions apply only to plants of this area. Distribution is first given for this area only, followed by distribution outside this area, if known from elsewhere.

#### KEY TO PISTILLATE WILLOWS OF THE ROCKY MOUNTAIN STATES

1. Bracts subtending flowers usually yellowish, green, or white (tan), deciduous by the time capsules are mature; styles 1 mm or less long; plants often trees, native or introduced (Subg. *Salix*). . . . . 2.
  2. Leaf blades mostly linear or nearly so, rarely narrowly elliptic; styles 0.2 mm or less long; bud scales without free overlapping margins. . . . . 3.
    3. Leaf blades 0.5–3.5 cm long; pistillate aments 0.7–2 cm long; capsules pubescent; S Arizona & New Mexico. . . . . 11. *S. taxifolia*.
    3. Leaf blades 2–13 cm long; pistillate aments 1.5–6 cm long; capsules glabrous or pubescent. . . . . 4.
      4. Leaves green on both sides, often pubescent; flower bracts lanceolate or lance-linear, pubescent or sometimes glabrate. . . . .  
. . . . . 12. *S. exigua*.
      4. Leaves usually glaucous or glaucescent beneath, glabrous when expanded; flower bracts usually broader, glabrous or sometimes pubescent at base. . . . . 13. *S. melanopsis*.
2. Leaf blades lance-linear or broader; styles 0–1 mm long; bud scales with or without free overlapping margins. . . . . 5.
  5. Bud scales with free overlapping margins, usually pointed at tip. . . 6.
    6. Leaf blades green above and beneath or slightly more pale beneath but not glaucescent. . . . . 2. *S. gooddingii*.
    6. Leaf blades glaucous or glaucescent beneath. . . . . 7.
      7. Latest developing leaves narrowly lanceolate, the margins gradually tapering to tip (straight sides), somewhat coriaceous; capsules usually ovate in outline. . . . . 1. *S. bonplandiana*.
      7. Latest developing leaves lanceolate to ovate, the margins somewhat abruptly tapering to tip (sides incurved just before tip), not coriaceous; capsules lanceolate in outline. . . . .  
. . . . . 3. *S. amygdaloides*.
  5. Bud scales without free overlapping margins, usually rounded at tip. . . 8.
    8. Leaf blades glaucous or glaucescent beneath. . . . . 9.
      9. Branchlets very long and hanging straight downward (weeping willow). . . . . 10. *S. babylonica*.
      9. Branchlets short or long, erect to ascending. . . . . 10.
        10. Margins of leaves of floriferous branchlets weakly or not at all glandular; introduced trees. . . . . 11.
        11. Twigs brittle at base, easily broken off; leaves glabrous when expanded (crack willow). . . . . 9. *S. fragilis*.



- 11. Twigs not brittle at base; leaves often pubescent (white willow). . . . . 8. *S. alba*.
- 10. Margins of leaves of floriferous branchlets usually strongly glandular; native trees or shrubs. . . . . 12.
- 12. Capsules mostly 7 mm or less long, usually dull, maturing in spring (March-June); pistillate aments 2-8 cm long. . . . . 7. *S. lasiandra*.
- 12. Capsules mostly 7-11 mm long when mature, somewhat shiny, maturing in summer (July-September); pistillate aments 2-4 cm long. . . . . 5. *S. serissima*.
- 8. Leaf blades green on both sides or slightly more pale beneath but not glaucescent. . . . . 13.
- 13. Plants introduced trees, not known to escape cultivation. . . . . 4. *S. pentandra*.
- 13. Plants native shrubs or trees. . . . . 14.
- 14. Capsules mostly 7-11 mm long when mature, somewhat shiny, maturing in summer (July-September); pistillate aments 2-4 cm long. . . . . 5. *S. serissima*.
- 14. Capsules mostly 7 mm or less long, usually dull, maturing in spring (March-June); pistillate aments 2-8 cm long. . . . . 15.
- 15. Leaf blades mostly about 3 times as long as wide; South Dakota & E Colorado. . . . . 6. *S. lucida*.
- 15. Leaf blades mostly 4 or more times as long as wide. . . . . 7a. *S. lasiandra* var. *caudata*.
- 1. Bracts subtending flowers usually brown, black, or reddish, rarely yellowish or greenish, persistent; styles 0-3 mm long; native shrubs, rarely tree-like (Subg. *Vetrix*). . . . . 16.
- 16. Capsules glabrous. . . . . 17.
- 17. Plants creeping, 1-3 cm high, the leaves 7(-9) mm or less long, near or above timberline. . . . . 16. *S. rotundifolia*.
- 17. Plants usually upright, mostly over 20 cm high, the larger leaves usually well over 10 mm long; most species below timberline. . . . . 18.
- 18. Leaves glaucous or glaucescent beneath (rarely not expanded in fruit). . . . . 19.
- 19. Styles averaging 0.7 mm or less long. . . . . 20.
- 20. Stipes 2-4 mm long; leaf blades oblong, oblanceolate, or narrowly obovate, somewhat leathery, entire; N Idaho. . . . . 17. *S. pedicellaris*.
- 20. Stipes sometimes as much as 2 mm long but then the leaf blades not as above. . . . . 21.
- 21. Plants of the mountains of Idaho, Montana, & NW Wyoming; leaf blades glabrous and entire (or a few serrulate), elliptic to elliptic-obovate; floriferous branchlets (3)5-15 mm long; stipes 0.3-1.5(2) mm long. . . . . 34. *S. farriæ*.
- 21. Plants without characters combined as above. . . . . 22.
- 22. Twigs usually pruinose, especially at nodes; stipes 0.3-1 mm long. . . . . 31. *S. irrorata*.



22. Twigs not pruinose; stipes 0.5–4.5 mm long. . . . . 23.
23. Stipes of normally developed capsules 2–4.5 mm long; leaves usually toothed; plains or mountains. . . . . 43. *S. lutea*.
23. Stipes 0.5–2 mm long; leaves often entire; along streams in deserts, plains, and foothills. . . . . 24.
24. Leaf blades oblanceolate or oblong to obovate, dark green above, white-glaucous beneath; SW Idaho, Nevada, Arizona, S Utah, & W New Mexico. . . . . 32. *S. lasiolepis*.
24. Leaf blades narrowly elliptic or lanceolate, dull green above, light bluish-green beneath; Nevada, Arizona, Utah, New Mexico, Colorado, & SE Wyoming. . . . . 44. *S. ligulifolia*.
19. Styles averaging over 0.7 mm long. . . . . 25.
25. Plants of S Wyoming, Colorado, Utah, Arizona, & New Mexico. . . . . 42. *S. monticola*.
25. Plants of N Wyoming, South Dakota, Montana, & Idaho. . . . . 26.
26. Leaf blades glabrous, entire (rarely a few serrulate), elliptic to elliptic-obovate; floriferous branchlets (3)5–15 mm long. . . . . 34. *S. farriae*.
26. Leaf blades pubescent at least when young, toothed, the shape various; floriferous branchlets 0–30 mm long. . . . . 27.
27. Floriferous branchlets (5)10–30 mm long. . . . . 35. *S. barclayi*.
27. Floriferous branchlets 0–8(12) mm long. . . . . 28.
28. Aments, or some of them, at tips of twigs of previous year; styles 1–3 mm long; leaves very finely glandular-toothed. . . . . 48. *S. tweedyi*.
28. Aments not at tips of twigs; styles 0.5–1.8 mm long; leaves crenate-serrate. . . . . 33. *S. pseudomonticola*.
18. Leaves not glaucous or glaucescent beneath. . . . . 29.
29. Plants of east-central Arizona. . . . . 41. *S. arizonica*.
29. Plants of Colorado, Utah, Nevada & northward. . . . . 30.
30. Styles 1–3 mm long; some aments at tips of twigs of previous year; leaves very finely glandular-toothed. . . . . 48. *S. tweedyi*.
30. Styles 0.2–1.5 mm long; aments not at tips of twigs; leaves various. . . . . 31.
31. Aments mostly 0.8–2 cm long; stipes 0–0.8 mm long; plants mostly less than 2 m high; Colorado, Utah, Nevada, Wyoming, Idaho, & SW & C Montana. . . . . 37. *S. wolfii*.



31. Aments mostly (1)2-9 cm long; stipes (0.3)0.5-4 mm long; plants 0.2-6 m high. . . . . 32.
32. Leaves of floriferous branchlets little if at all reduced, the branchlets 8-30 mm long; leaf blades mostly ovate, broadly elliptic, or obovate, often densely pubescent with long, loose hairs; Idaho & W Montana. . . . . 36. *S. commutata*.
32. Leaves of floriferous branchlets usually much reduced, the branchlets (1)2-10(15) mm long; leaf blades mostly lanceolate, narrowly elliptic, or oblanceolate, rarely ovate or obovate, variously pubescent or glabrous. . . . . 33.
33. Leaves thin and somewhat translucent; stipes (1.5)2-4 mm long; styles 0.2-0.7(1) mm long; NW Wyoming, Montana & Idaho. . . . . 45. *S. monochroma*.
33. Leaves thickish; stipes 0.5-2(2.5) mm long; styles 0.3-1.2(1.5) mm long. . . . . 40. *S. boothii*.
16. Capsules pubescent. . . . . 34.
34. Plants creeping shrubs 1-8 cm high, near or above timberline. . . . . 35.
35. Leaf tip usually rounded or obtuse; leaves glaucous and prominently reticulate-veined beneath; styles less than 0.5 mm long; nectaries 2. . . . . 15. *S. reticulata*.
35. Leaf tip usually pointed; leaves glaucous or not beneath, usually not reticulate-veined; styles 0.3-2 mm long; nectary 1. . . . . 36.
36. Leaf blades mostly elliptic to oval, glaucous beneath, those of previous year usually not persisting; pistillate aments 1-5 cm long. . . . . 20. *S. arctica*.
36. Leaf blades narrowly elliptic to elliptic, usually green beneath, those of previous year often persisting; pistillate aments mostly 0.6-2 cm long. . . . . 21. *S. cascadenis*.
34. Plants erect shrubs or trees mostly over 20 cm high (*S. glauca* & *S. vestita* rarely creeping), only rarely above timberline. . . . . 37.
37. Twigs of previous year (and sometimes those of season) pruinose, sometimes only apparent at nodes especially behind buds. . . . . 38.
38. Aments 8-20(25) mm long (if to 40 mm, the leaves glabrous or puberulent), loosely flowered, usually with leafy floriferous branchlets 2-18 mm long; stipes 1-3 mm long (as little as 0.5 mm in specimens with glabrous or puberulent leaves). . . . . 39.
39. Leaves sericeous on both sides, obscurely if at all glaucous; bracts usually brown or tan, mostly twice or more as long as wide. . . . . 24. *S. geyeriana*.
39. Leaves with few hairs beneath and glaucous; bracts usually blackish, mostly less than twice as long as wide. . . . . 25. *S. lemmonii*.
38. Aments 15-60 mm long, densely flowered, sessile or nearly so; stipes 0.1-0.8 mm long; leaves usually silvery-pubescent be-



- neath. . . . . 29. *S. drummondiana*.
37. Twigs not pruinose (rarely so in *S. planifolia*). . . . . 40.
40. Leaf blades elliptic-obovate to oval, dark green above, silvery-hairy beneath (becoming glabrate); some aments at tips of shoots of season; Montana. . . . . 14. *S. vestita*.
40. Leaf blades not as above; aments usually not at tips of shoots of season (on branchlets with no or reduced leaves). . . . . 41.
41. Leaf blades narrowly elliptic, oblong, or oblanceolate (sometimes obovate in NW Montana, N Idaho, & W Nevada), usually densely white- or silvery-hairy beneath, glabrous or glabrate and green above; stipes 1 mm or less long. . . . . 42.
42. Leaves white-hairy beneath; twigs pubescent. . . . . 30. *S. candida*.
42. Leaves silvery-hairy beneath; twigs glabrous or pubescent. . . . . 43.
43. Pistillate aments sessile or nearly so; widespread. . . . . 29. *S. drummondiana*.
43. Pistillate aments with leafy floriferous branchlets 5–20 mm long; NW Montana, N Idaho, & W Nevada. . . . . 46. *S. sitchensis*.
41. Leaf blades often broader, not densely white- or silvery-hairy beneath, or if so, then similar above (rarely not expanded in fruit); stipes various. . . . . 44.
44. Leaves equally green on both sides, pubescent. . . . . 45.
45. Styles 1–2.5 mm long; twigs glutinous; aments sessile or nearly so, some at tips of twigs of previous year. . . . . 47. *S. barrattiana*.
45. Styles 0.2–1.5 mm long; twigs not glutinous; aments not at tips of twigs, subsessile or with floriferous branchlets to 25 mm long. . . . . 46.
46. Aments 1–5 cm long; either the young leaves with prominently glandular margins or the capsules mostly 7 mm or more long. . . . . 47.
47. Mature capsules 3–4(7) mm long; some smallest leaves, especially those on floriferous branchlets, with conspicuous glands which extend out beyond margin at a right angle. . . . . 39. *S. eastwoodiae*.
47. Mature capsules mostly over 7 mm long; leaves rarely glandular as above. . . . . 38. *S. orestera*.
46. Aments 0.8–2 cm long; young leaves usually lacking glands on margins; capsules usually less than 6 mm long. . . . . 37. *S. wolfii*.
44. Leaves white-glaucous or otherwise lighter beneath, glabrous or pubescent (rarely not expanded in fruit). . . . . 48.



48. Styles 1–2.5 mm long; twigs glutinous; aments sessile or nearly so, some at tips of twigs of previous year; Montana & Wyoming. . . . . 47. *S. barrattiana*.
48. Styles 0.1–1.5 mm long; twigs not glutinous; aments sessile or on floriferous branchlets to 25 mm long, not at tips of twigs of previous year. . . . . 49.
49. Leaf blades mostly 5 or more times as long as wide, usually sharply serrate; styles 0.1–0.3 mm long; South Dakota, Montana, & Colorado. . . . . 23. *S. petiolaris*.
49. Leaf blades rarely as much as 5 times as long as wide, entire or bluntly toothed; styles 0.1–1.5 mm long. . . . . 50.
50. Stipes mostly 2–5 mm long; styles 0.4 mm or less long; flower bracts light brown or yellowish. . . . . 22. *S. hebbiana*.
50. Stipes 3 mm or less long; styles 0.1–1.5 mm long; flower bracts yellowish or light brown to black. . . . .
51. (Couplet moved to left margin of key.)
51. Aments mostly appearing with the leaves, on leafy floriferous branchlets 2–25 mm long. . . . . 52.
52. Leaf blades glabrous or puberulent; plants to 5 m high. . . . . 25. *S. lemmonii*.
52. Leaf blades obviously pubescent (rarely glabrous in plants to 1.5 m high). 53.
53. Leaf blades oblanceolate to elliptic; stipes 0.5–2 mm long; W Nevada. . . . . 38. *S. orestera*.
53. Leaf blades elliptic to elliptic-obovate or oblong; stipes 0–1.5 mm long; not known from Nevada. . . . . 54.
54. Aments 0.5–2 cm long; floriferous branchlets 2–10 mm long; stipes less than 0.5 mm long; petioles mostly 1–3 mm long. . . . .
- . . . . . 18. *S. brachycarpa*.
54. Aments (1.5)2–5 cm long; floriferous branchlets 5–25 mm long; stipes 0–1.5 mm long; petioles often over 3 mm long. . . . .
- . . . . . 19. *S. glauca*.
51. Aments mostly appearing before the leaves, sessile or subsessile (rarely on mostly naked branchlets to 13 mm long). . . . . 55.
55. Stipes 0–1 mm long; stigmas usually less than 0.5 mm long; twigs of previous year often reddish and shiny. . . . . 28. *S. planifolia*.
55. Stipes (0.8)1–3 mm long; stigmas usually over 0.5 mm long; twigs of previous year yellowish to reddish-brown, dull. . . . . 56.
56. Twigs of previous year glabrous; leaves, if present, elliptic; bark without a skunky odor; wet areas in South Dakota, NE Wyoming, Montana, & Idaho. . . . . 26. *S. discolor*.
56. Twigs of previous year sometimes hairy; leaves, if present, obovate to oblanceolate; freshly stripped bark of living twigs of previous year usually with a skunky odor; widespread mostly in drier locations in upland forests and clearings. . . . . 27. *S. scouleriana*.



## KEY TO STAMINATE WILLOWS OF THE ROCKY MOUNTAIN STATES

1. Stamens 3–8 per flower. . . . . 2.
  2. Bud scales with free overlapping margins. . . . . 3.
    3. Leaf blades not glaucous beneath. . . . . 2. *S. gooddingii*.
    3. Leaf blades glaucous beneath. . . . . 4.
      4. Latest developing, expanded leaves lanceolate to ovate, with margins incurved just before tip, not coriaceous. 3. *S. amygdaloides*.
      4. Latest developing, expanded leaves lanceolate with straight margins, somewhat coriaceous. . . . . 1. *S. bonplandiana*.
  2. Bud scales without free overlapping margins. . . . . 5.
    5. Plants introduced trees, not known to escape cultivation; leaves pale beneath but not glaucous. . . . . 4. *S. pentandra*.
    5. Plants native shrubs, rarely tree-like; leaves green on both sides or glaucous beneath. . . . . 6.
      6. Aments maturing in summer (July-August). . . . . 5. *S. serissima*.
      6. Aments maturing in spring (March-June). . . . . 7.
        7. Leaf blades mostly about 3 times as long as wide. . . . . 6. *S. lucida*.
        7. Leaf blades mostly 4 or more times as long as wide. . . . . 7 & 7a. *S. lasiandra*.
1. Stamens 1 or 2 per flower. . . . . 8.
  8. Anthers solitary. . . . . 46. *S. sitchensis*.
  8. Anthers 2 per flower. . . . . 9.
    9. Plants creeping, 1–8 cm high, near or above timberline. . . . . 10.
      10. Leaves 7(–9) mm or less long, green on both sides. . . . . 16. *S. rotundifolia*.
      10. Leaves, or some of them, over 7 mm long, whitish-glaucous beneath, except *S. cascadiensis*. . . . . 11.
        11. Leaf tip usually rounded; leaves glaucous and prominently reticulate-veined beneath; flower bracts glabrous to short-hairy. . . . . 15. *S. reticulata*.
        11. Leaf tip usually pointed; leaves glaucous or not beneath, usually not reticulate-veined; flower bracts mostly long-hairy. . . . . 12.
          12. Leaf blades mostly elliptic to oval, glaucous beneath, those of the previous year usually not persisting. 20. *S. arctica*.
          12. Leaf blades narrowly elliptic to elliptic, usually equally green on both sides, those of the previous year often persisting. . . . . 21. *S. cascadiensis*.
    9. Plants mostly upright and mostly over 20 cm high, only rarely above timberline. . . . . 13.
      13. Plants introduced trees. . . . . 14.
        14. Branchlets very long and hanging straight downward. . . . . 10. *S. babylonica*.
        14. Branchlets short or long, erect to ascending. . . . . 15.
          15. Twigs brittle at base, easily broken off; leaves glabrous when expanded. . . . . 9. *S. fragilis*.



15. Twigs not brittle at base; leaves often pubescent. . . . . 8. *S. alba*.
13. Plants native shrubs, rarely tree-like. . . . . 16.
16. Twigs of previous year, and sometimes those of season, pruinose, sometimes only apparent at nodes, especially behind buds. . . . . 17.
17. Aments precocious, sessile or nearly so. . . . . 18.
18. Flower bracts mostly obovate or suborbicular, fringed with relatively short hairs. . . . . 31. *S. irrorata*.
18. Flower bracts mostly narrower, with very long hairs. . . . . 29. *S. drummondiana*.
17. Aments mostly coetaneous with at least short floriferous branchlets. . . . . 19.
19. Leaves sericeous and nearly the same color on both sides; flower bracts mostly brownish. 24. *S. geyeriana*.
19. Leaves sericeous on one side at most, obviously glaucous beneath; flower bracts mostly black. . . . . 25. *S. lemmonii*.
16. Twigs not pruinose (rarely so in *S. planifolia*). . . . . 20.
20. Twigs glutinous, staining pressing papers yellow or green. . . . . 47. *S. barrattiana*.
20. Twigs not glutinous. . . . . 21.
21. Aments, or some of them, at tips of twigs of previous year; twigs often with long, spreading hairs. . . . . 48. *S. tweedyi*.
21. Aments usually not at tips of twigs of previous year; twigs mostly without long, spreading hairs. . . . . 22.
22. Leaf blades elliptic-obovate to oval, dark green above, silvery-hairy beneath (becoming glabrate); aments at tips of ordinary shoots of season; Montana. . . . . 14. *S. vestita*.
22. Leaf blades not as above; aments usually at tips of modified shoots (on branchlets with no or reduced leaves). . . . . 23.
23. Aments mostly precocious, usually sessile or nearly so; flower bracts mostly black or dark brown, at least at tip. The following are difficult to distinguish using described characteristics. The most obvious tendencies are listed: 27. *S. scouleriana* — drier upland forests and clearings. 28. *S. planifolia* — twigs often chestnut or red and shiny; often subalpine. 42. *S. monticola* — early flowering; S Wyoming, Colorado, New Mexico, Arizona, Utah. 43. *S. lutea* — aments very slender and elongate; bracts often bicolored. 32. *S. lasiolepis* — bracts mostly suborbicular, fringed with short hairs; SW Idaho, S Utah, Nevada, Ari-



- zona, New Mexico. 44. *S. ligulifolia* — plains and foothill streams; SE Wyoming, Colorado, New Mexico, Arizona, S Utah, Nevada. 25. *S. lemmonii* — aments loosely flowered. 33. *S. pseudomonticola* — early flowering; N Wyoming, South Dakota, Montana, Idaho. 26. *S. discolor* — very early flowering; South Dakota, NE Wyoming, Montana, Idaho.
23. Aments mostly coetaneous or serotinous, usually with at least short, leafy floriferous branchlets; flower bracts sometimes greenish, yellowish, or light brown. . . . . 24.
24. Leaves densely white-tomentose beneath, greenish above. . . . . 30. *S. candida*.
24. Leaves not white-tomentose except rarely so on both sides. . . . .
25. (Couplet moved to left margin of key.)
25. Leaves glaucous or glaucescent beneath. . . . . 26.
26. Young leaves mostly glabrous. . . . . 27.
27. Leaves somewhat leathery with rolled margins. . . . . 17. *S. pedicellaris*.
27. Leaves not leathery, the margins mostly flat. . . . . 34. *S. farriar*.
26. Young leaves mostly pubescent. The following are difficult to distinguish using described characteristics. The most obvious tendencies are listed: 13. *S. melanopsis* — aments slender and elongate; bracts green or yellowish to tan. 22. *S. bebbiana* — margins of bud scales depressed; twigs of previous year reddish-purple, appressed-hairy. 43. *S. lutea* — aments slender and elongate; bracts bicolored. 42. *S. monticola* — early flowering; S Wyoming, Colorado, New Mexico, Arizona, Utah, mostly in mountains. 32. *S. lasiolepis* — bracts mostly suborbicular, fringed with short hairs; SW Idaho, S Utah, Nevada, Arizona, New Mexico. 44. *S. ligulifolia* — plains and foothill streams; SE Wyoming, Colorado, New Mexico, Arizona, S Utah, Nevada. 25. *S. lemmonii* — aments loosely flowered. 19. *S. glauca* — mostly subalpine; petioles mostly 3 mm or more long. 18. *S. brachycarpa* — petioles mostly 1–3 mm long; aments about twice as long as wide. 35. *S. barclayi* — mountains; NW Wyoming, Montana, Idaho. 38. *S. orestera* — extreme W Nevada. 23. *S. petiolaris* — aments loosely flowered; Montana, South Dakota, E Colorado.
25. Leaves not glaucous or glaucescent beneath. . . . . 28.
28. Leaves linear or nearly so. . . . . 29.
29. Leaf blades 0.5–3.5 cm long. . . . . 11. *S. taxifolia*.
29. Leaf blades 2–13 cm long. . . . . 12. *S. exigua*.
28. Leaves broader than linear. . . . . 30.
30. Plants of Arizona. . . . . 41. *S. arizonica*.
30. Plants not known from Arizona. . . . . 31.
31. Leaves of floriferous branchlets usually with prominent glands on margins which stand out at a right angle. . . . . 39. *S. eastwoodiae*.
31. Leaves of floriferous branchlets without glands as above. . . . . 32.
32. Leaves thin and somewhat translucent. 45. *S. monochroma*.



32. Leaves thickish, not translucent. . . . . 33.  
 33. Leaves of floriferous branchlets little if at all reduced; leaf blades mostly ovate, broadly elliptic, or obovate, often densely pubescent with long, loose hairs. . . . .  
 . . . . . 36. *S. commutata*.  
 33. Leaves of floriferous branchlets usually much reduced; leaf blades mostly lanceolate, narrowly elliptic, or oblanceolate, rarely broader, variously pubescent or glabrous. . . . . 34.  
 34. Aments mostly less than 2 cm long; plants mostly less than 1(-2) m high. . . . . 37. *S. wolfii*.  
 34. Aments mostly 2 cm or more long; plants often over 2 m high. . . . . 35.  
 35. Plants of extreme west-central Nevada. . . . .  
 . . . . . 38. *S. orestera*.  
 35. Plants widespread. . . . . 40. *S. boothii*.

**Salix** Linnaeus, Gen. Pl. ed. 5. 447. 1754. TYPE SPECIES: *S. alba* L.

### Subgenus **Salix**

I. Section *Humboldtianae* Pax in Engl. & Prantl, Nat. Pflanzenf. III, 1: 36. 1887. TYPE SPECIES: *S. humboldtiana* Willd.

1. **Salix bonplandiana** HBK., Nov. Gen. & Sp. 2: 24. 1817.

TYPE: Syntypes from several localities in Mexico (P).

*Salix laevigata* Bebb, Am. Naturalist 8: 202. 1874. TYPE: Syntypes from several localities in California (F).

*Salix toumeyi* Britt. in Britt. & Shafer, N. Am. Trees 187. 1908. TYPE: Sabino Canyon, Santa Catalina Mts., Pima Co., Arizona, *Shear 4201* (Lectotype by Schneider, 1918, NY).

Tree to 15 m high; leaf blades lanceolate or lance-linear or the younger oblanceolate, 2-15 cm long, acute or acuminate, entire or serrate, glaucous beneath, glabrous when mature; stamens 3-8; anthers 0.2-0.6 mm long; pistillate aments appearing at various times, 2-10 cm long, sessile or with leafy floriferous branchlets to 3 cm long; capsules glabrous; stipes 1-2.8 mm long; styles 0-0.4 mm long; bracts yellowish or greenish, pubescent, deciduous.  $2n = 42(?)$ .

Stream banks in Arizona, New Mexico, southern Nevada, and southern Utah. Additional distribution: California, Mexico, and Guatemala.

2. **Salix gooddingii** Ball, Bot. Gaz. 40: 376. 1905. TYPE: Muddy



Creek, Clark Co., Nevada, *Goodding 689* (Holotype: US; isotype: RM!).

Shrub or tree to 30 m high; leaf blades linear-lanceolate or narrowly elliptic or oblong, 3–12 cm long, acuminate, serrate, green or pale beneath, glabrous when mature; stamens 3–8; anthers 0.3–0.6 mm long; pistillate aments appearing with the leaves, 2.5–7 cm long, with leafy floriferous branchlets 0.7–3 cm long; capsules glabrous or pubescent; stipes 1–2.5 mm long; styles 0–0.4 mm long; bracts yellowish, pubescent, deciduous.  $2n = 38$ .

Stream banks in Arizona, New Mexico, southern Utah, southern Nevada, and possibly southeast Colorado. Additional distribution: California, northern Mexico, and western Texas.

3. ***Salix amygdaloides*** Anderss., Proc. Am. Acad. Arts **4**: 53. 1858. TYPE: *Neuwied*, Ft. Pierre, South Dakota.

Tree to 17 m high, sometimes shrubby; leaf blades lanceolate or ovate, 4–12 cm long, long-acuminate at tip when expanded, glaucous or glaucescent beneath, serrate, glabrous except when young; stamens usually 5–8; anthers 0.3–0.6 mm long; pistillate aments appearing with the leaves, 2–10 cm long, with leafy floriferous branchlets (5)10–30(35) mm long; capsules glabrous; stipes 1.2–3 mm long; styles 0.5 mm or less long; bracts yellowish or white, pubescent, deciduous.  $2n = 38$ .

Flood plains, stream banks, and shores on the plains. Throughout the region. General distribution: British Columbia to Quebec south to northern Mexico, Missouri, Pennsylvania, and Massachusetts.

This species is often confused with *Salix lasiandra* but the difference in bud scales (see key) is absolute.

II. Section *Salicaster* Dumortier, Fl. Belg. 14. 1827. TYPE SPECIES: *S. pentandra* L.

4. ***Salix pentandra*** L., Sp. Pl. 1016. 1753. TYPE: None designated, *Europae paludibus montosis duris* cited.

Introduced tree to 20 m high; leaf blades ovate or broadly lanceolate or elliptic, 3–12 cm long, acuminate, serrate, pale but not glaucous beneath, glabrous; stamens usually 5; anthers 0.4–0.8 mm



long; pistillate aments appearing with or after the leaves, 2–6 cm long, with leafy floriferous branchlets 2–6 cm long; capsules glabrous; stipes 0.2–1.2 mm long; styles 0.2–0.7 mm long; bracts yellow or greenish, pubescent, deciduous.  $2n = 57, 76$ .

Sparingly planted. Native of Europe and western Asia.

5. **Salix serissima** (Bailey) Fernald, *Rhodora* **6**: 6. 1903.

*Salix lucida* var. *serissima* Bailey in Arthur et al., Bull. Geol. Nat. Hist. Surv. Minn. **3**: 19. 1887. TYPE: Mud River, Vermillion Lake, Minnesota, Arthur, Bailey, & Holway B357 (Lectotype by Ball, 1921, F).

Shrub to 5 m high; leaf blades lanceolate or elliptic, 3–10 cm long, acute or acuminate, serrate, glaucescent or pale beneath, glabrous; stamens 3–8; anthers 0.4–0.7 mm long; pistillate aments appearing after the leaves, maturing in summer, 2–4 cm long, with leafy floriferous branchlets 1–4 cm long; capsules glabrous; stipes 0.8–2 mm long; styles 0.1–0.8 mm long; bracts yellow, green, or whitish, pubescent, deciduous.

Swamps and bogs. Very local in Montana, South Dakota, and Larimer Co., Colorado. General distribution: District of Mackenzie to Newfoundland south to Colorado, Indiana, and New Jersey.

This species is called the autumn willow because the aments mature in late summer or early fall. All the other Rocky Mountain, non-alpine willows have aments maturing in spring or early summer.

6. **Salix lucida** Muhl., *Neue Schriften Ges. Berlin* **4**: 239. 1803.

TYPE: Lancaster, Pennsylvania, *Muhlenberg s.n.* (Holotype: PH!).

Shrub or tree to 6 m high; leaf blades lanceolate, lance-ovate, or elliptic, 3–15 cm long, acute or acuminate, serrate, pale beneath, glabrous except when young; stamens 3–8; anthers 0.5–0.9 mm long; pistillate aments appearing with the leaves, 2–7 cm long, with leafy floriferous branchlets 1–3 cm long; capsules glabrous; stipes 0.5–2 mm long; styles 0.3–0.8 mm long; bracts yellow or greenish, pubescent, deciduous.  $2n = 76$ .

Stream banks and swamps in South Dakota and extreme eastern Colorado. General distribution: Labrador to Saskatchewan south to Virginia and Colorado.

See discussion under 7a.



7. **Salix lasiandra** Benth., Pl. Hartw. 335. 1857. TYPE: Sacramento River, California, *Hartweg s. n.* (Holotype: K; isotype, GH!).

*Salix fendleriana* Anderss., Proc. Am. Acad. Arts 4: 54. 1858. TYPE: New Mexico, *Fendler 816*.

*Salix arguta* Anderss., Kongl. Sv. Vet.-Akad. Handl. 6(1): 32. 1867. TYPE: New Mexico, *Fendler 816*.

Shrub or small tree to 10 m high; leaf blades lanceolate to sometimes elliptic, usually acuminate when expanded, 2–15(20) cm long, toothed, glaucous beneath, glabrous; stamens 3–8; anthers 0.5–1 mm long; pistillate aments appearing with the leaves, 2–8 cm long, with leafy floriferous branchlets 10–45 mm long; capsules glabrous; stipes 0.8–2.2 mm long; styles 0.2–1 mm long; bracts yellowish, deciduous, pubescent to glabrate.  $2n = 76$ .

Stream banks in Arizona, New Mexico, Colorado, Utah, Nevada, Idaho, and northwest Montana. General distribution: Alaska to District of Mackenzie south to California and New Mexico.

- 7a. **Salix lasiandra** var. **caudata** (Nutt.) Sudw., Bull. Torrey Bot. Club 20: 43. 1893.

*Salix pentandra*  $\beta$  *caudata* Nutt., N. Am. Sylva 1: 61. 1842. TYPE: None designated, Rocky Mountains to Oregon cited.

*Salix caudata* (Nutt.) Heller, Muhlenbergia 2: 186. 1906.

Differing from var. *lasiandra* in having the leaves not glaucous beneath.  $2n = 76$ .

Stream banks throughout the region. General distribution: British Columbia and Alberta south to California and New Mexico.

*Salix lucida* and the two varieties of *S. lasiandra* appear to have identical flavonoid profiles. More study is needed to determine the relationship between these taxa. The former appears to have leaves that are more acuminate at the tip. Leaf length with respect to width is not always a reliable character.

### III. Section *Salix*. TYPE SPECIES: *S. alba* L.

8. **Salix alba** L., Sp. Pl. 1021. 1753. TYPE: None designated, *Europae* cited.

Introduced tree to 30 m high; branchlets not brittle; leaf blades lanceolate to elliptic, 3–15 cm long, acuminate, serrate, glaucous or



lighter beneath, pubescent at least when young; stamens 2; anthers 0.5–0.9 mm long; pistillate aments appearing with the leaves, 3–7 cm long, with leafy floriferous branchlets 1–4 cm long; capsules glabrous; stipes 0–1 mm long; styles 0.1–0.7 mm long; bracts yellow or greenish, pubescent, deciduous.  $2n = 76$ .

Sparingly planted. Native of Europe and western Asia.

*Salix alba* is known to hybridize with *S. fragilis*.

9. ***Salix fragilis*** L., Sp. Pl. 1017. 1753. TYPE: None designated, *Europae borealibus* cited.

Introduced tree to 20 m high; branchlets brittle at base; leaf blades lanceolate or narrowly elliptic, 3–17 cm long, acute or acuminate, serrate, glaucous or glaucescent beneath, glabrous when mature; stamens 2; anthers 0.5–1.2 mm long; pistillate aments appearing with the leaves, 2–8 cm long, with leafy floriferous branchlets 1–5 cm long; capsules glabrous; stipes 0.5–1 mm long; styles 0.3–0.8 mm long; bracts yellow or greenish, pubescent, deciduous.  $2n = 38, 76, 114$ .

Widely planted. Native of Europe and western Asia.

This is by far the most common introduced willow in the region, and it is known to hybridize with *Salix alba*.

10. ***Salix babylonica*** L., Sp. Pl. 1017. 1753. TYPE: None designated, *Oriente* cited.

Introduced tree to 12 m high; branchlets long and hanging downward; leaf blades linear-lanceolate, 3–12 cm long, acuminate, serrate, glaucous or glaucescent beneath, glabrous when mature; stamens 2; pistillate aments appearing with the leaves, 1–2.5 cm long, with leafy floriferous branchlets 2–15 mm long; capsules glabrous, sessile; styles lacking or to 0.5 mm long; bracts yellow or greenish, pubescent, deciduous.  $2n = 76$ .

Sparingly planted. Native of Asia. Weeping willow.

- IV. Section *Longifoliae* Pax in Engl. & Prantl, Nat. Pflanzenf. III, 1: 36. 1887. TYPE SPECIES: *S. exigua* Nutt.

11. ***Salix taxifolia*** HBK., Nov. Gen. & Sp. 2: 22. 1817. TYPE: None designated, *Colitur in hortis Mexici, Queretari, Zelayae* cited (P).



Tree or shrub to 12 m high; leaf blades mostly linear, 5–35 mm long, acute or acuminate, entire or nearly so, green on both sides, pubescent; stamens 2; anthers 0.3–0.6 mm long; pistillate aments appearing with the leaves, 0.7–2 cm long, 1 to several terminating branchlets of season; capsules pubescent; stipes 0–0.5 mm long; styles 0–0.2 mm long; bracts yellowish, pubescent, deciduous.

Stream banks in southern Arizona and New Mexico. Additional distribution: southwest Texas, Mexico, Guatemala, and Puerto Rico.

12. ***Salix exigua*** Nutt., N. Am. Sylva 1: 75. 1842. TYPE: Border of the Oregon a little below its confluence with the Wahlamet, *Nuttall*.

*Salix longifolia* Muhl., Neue Schriften Ges. Berlin 4: 238. 1803, not Lam. in 1778.

TYPE: Lancaster, Pennsylvania, *Muhlenberg s. n.* (Holotype, PH!).

*Salix interior* Rowlee, Bull. Torrey Bot. Club 27: 253. 1900. Based on *S. longifolia* Muhl.

*Salix argophylla* Nutt., N. Am. Sylva 1: 71. 1842. TYPE: River Boisée towards its junction with the Shoshonee [Snake], Idaho, *Nuttall*.

*Salix fluviatilis* of authors, not Nutt.

*Salix nevadensis* Wats., Am. Naturalist 7: 302. 1873. TYPE: near Carson City, Nevada, *Watson 1093* (Lectotype by Schneider 1919b, GH).

*Salix longifolia tenerrima* Henderson, Bull. Torrey Bot. Club 27: 354. 1900. TYPE: Elmore Co., Idaho, *Henderson* in 1895 (US).

*Salix tenerrima* (Henderson) Heller, Cat. N. Am. Pl. 2: 4. 1900.

*Salix stenophylla* Rydb., Bull. Torrey Bot. Club 28: 271. 1901. TYPE: Cuchara River below La Veta, Colorado, *Rydberg & Vreeland 6393* (NY).

*Salix linearifolia* Rydb. in Britt., Man. 316. 1901. TYPE: None designated, Minn. & Sask. to Indian Terr. & Colo. cited (NY).

Shrub to 5 m high; leaf blades linear to oblong, 2–13 cm long, entire or toothed, not glaucous, glabrous or pubescent; stamens 2; anthers 0.3–1.2 mm long; pistillate aments appearing with or after the leaves, 1.5–6 cm long, with usually leafy floriferous branchlets 5–25 mm long or at tips of long leafy branchlets; capsules glabrous or pubescent; stipes 0–1.5(2) mm long; styles to 0.2 mm long; bracts yellow or light brown, deciduous, pubescent or sometimes glabrate.  $2n = 38$ .

Stream banks, shores, and ditches throughout the region at mostly lower and middle elevations. General distribution: Alaska and Canada east to New Brunswick and south to northern Mexico, Mississippi, and Virginia.

This is the common narrow-leaved willow of the plains and



basins. The whole group is badly in need of detailed study which might well demonstrate the presence of more species than recognized here. The area of southern Idaho, eastern Oregon, and California is especially critical. A flavonoid survey of the group was inconclusive.

13. **Salix melanopsis** Nutt., N. Am. Sylva **1**: 78. 1842. TYPE: Fort Hall, Idaho, *Nuttall* in 1834.

Shrub to 5 m high; leaf blades linear or oblong, 2–12 cm long, toothed or subentire, usually glaucous or glaucescent beneath, glabrous, or pubescent when young; stamens 2; anthers 0.5–0.9 mm long; pistillate aments appearing with or after the leaves, 1.5–5 cm long, with usually leafy floriferous branchlets 3–20 mm long or at ends of long leafy branchlets; capsules glabrous or sometimes pubescent; stipes 0–0.5 mm long; styles 0–0.1 mm long; bracts yellow or greenish, glabrous to sometimes pubescent at base, deciduous.

Stream banks, mostly montane, in Montana, Wyoming, Colorado, Idaho, and reported from Utah and Nevada. Additional distribution: British Columbia, Alberta, Washington, Oregon, and California.

Subgenus **Vetrix** (Dumortier) Dumortier, Bull. Soc. Roy. Bot. Belg. **1**: 141. 1862. TYPE SPECIES: *S. caprea* L.

- V. Section *Chamaetia* Dumortier, Bijdr. Natuurk. Wetensch. **1**(1): 56. 1825. TYPE SPECIES: *S. reticulata* L.

14. **Salix vestita** Pursh, Fl. Am. Sept. 610. 1814. TYPE: Labrador, Herb. Lambert & Banks.

*Salix fernaldii* Blank., Mont. Agr. Coll. Sci. Stud. Bot. **1**: 46. 1905. TYPE: mountains above Stanton Lake, Flathead Co., Montana, *Williams 1031* (pistillate) (Lectotype here designated, MONT!).

Shrub to 1 m high; leaf blades elliptic-obovate to oval, 1.5–7 cm long, rounded at tip, entire or with obscure glands on margins, glaucous and usually silvery-hairy beneath; stamens 2; anthers 0.2–0.5 mm long; pistillate aments appearing after the leaves, 1–5 cm long, terminating the branches on naked branchlets 5–20 mm long; capsules pubescent; stipes lacking or to 0.5 mm long; styles lacking or to 0.4 mm long; bracts brown or yellowish, pubescent, persistent.



$2n = 38$ .

Subalpine in central (Big Snowy Mts.) and northwest Montana. General distribution: Labrador to District of Keewatin south to northern Manitoba and Newfoundland; southern British Columbia and Alberta, Montana, Washington, and northeast Oregon; central Asia.

15. ***Salix reticulata*** L., Sp. Pl. 1018. 1753, ssp. ***nivalis*** (Hook.) Löve et al., Arctic & Alp. Res. 3: 146. 1971.

*Salix nivalis* Hook., Fl. Bor. Am. 2: 152. 1838. TYPE: Rocky Mountains of southern Canada, *Drummond* (Holotype, K; fragment, A!).

*Salix saximontana* Rydb., Bull. N. Y. Bot. Gard. 1: 261. 1899. TYPE: Gray's Peak, Colorado, *Rydberg* in 1895 (NY).

*Salix aemulans* von Seemen, Engl. Bot. Jahrb. 29(65): 28. 1900. TYPE: Mt. Hesperus, Colorado, *Baker, Earle, & Tracy* 299 (Isotype: GH!).

Creeping shrub to 8 cm high; leaf blades elliptic to obovate or suborbicular, (4)7–30 mm long, entire, glaucous beneath, glabrous or glabrate; stamens 2; anthers 0.3–0.7 mm long; pistillate aments appearing with or after the leaves, 5–20 mm long, with mostly naked floriferous branchlets 3–20 mm long; capsules pubescent; stipes 0.5 mm or less long; styles less than 0.5 mm long; bracts green, reddish, or yellowish, glabrous or glabrate, persistent.  $2n = 38$ .

Alpine or subalpine throughout the region except for Arizona and South Dakota. General distribution of the subspecies: Alberta and British Columbia south to California and New Mexico.

The extremes of *Salix reticulata* ssp. *reticulata* in Alaska and Canada and ssp. *nivalis* are strikingly distinct in the field, but plants are not infrequently encountered that would be hard to identify without knowing the locality. Specifically, I have seen plants in Colorado which resemble those in Alaska. The flavonoid profiles of the two subspecies appear to be identical and the chromosome numbers are the same. It is likely that the northern and southern populations were isolated during glaciation and have since come back together. On the basis of morphology, chromosome number, and flavonoid chemistry, I do not think that they have diverged sufficiently to be reproductively isolated, but this suspicion needs to be confirmed experimentally. *Salix* × *solheimii* Kelso is a hybrid between this subspecies and *S. rotundifolia* ssp. *dodgeana*.



VI. Section *Myrtosalix* Kerner, Verh. Zool.-Bot. Ges. Wien (Abhandl.) **10**: 203. 1860. TYPE SPECIES: *S. myrsinites* L.

16. ***Salix rotundifolia*** Trautv., Nouv. Mem. Soc. Nat. Mosc. **2**: 304. 1832, ssp. ***dodgeana*** (Rydb.) Argus, Canad. J. Bot. **47**: 795. 1969.

*Salix dodgeana* Rydb., Bull. N. Y. Bot. Gard. **1**: 277. 1899. TYPE: Electric Peak, Yellowstone Park, Montana, *Rydberg & Bessey s. n.* (Lectotype by Schneider 1919a, NY!).

Creeping, matted shrub to 3 cm high; leaf blades elliptic or ovate to suborbicular, 2–7(9) mm long, entire, not glaucous, glabrous except ciliate on margins; stamens 2; anthers 0.3–0.7 mm long; pistillate aments appearing with or after the leaves, 2–9 flowered, usually terminating branches; capsules glabrous; stipes 0–0.8 mm long; styles 0.2–1 mm long; bracts reddish or brownish, glabrous except on upper margins, persistent.

Alpine or subalpine, usually on limestone, in northwest Wyoming and western Montana. Additional distribution of the subspecies: District of Mackenzie, Yukon, Alaska, and northeast USSR.

Leaves of previous seasons tend to persist giving this species the appearance of a dense carpet. Most evidence thus far supports inclusion of this plant under the boreal *Salix rotundifolia*. Argus (1969) discussed its morphology. I have collected both subspecies, and the flavonoid profiles appear identical. This is not necessarily evidence for their being conspecific, however, since the profiles of *S. arctica* and *S. cascadiensis* also appear identical. Our subspecies readily hybridizes with *S. reticulata* ssp. *nivalis* so the chromosome number may be  $2n = 38$ . My attempts to obtain a count were unsuccessful. Subspecies *rotundifolia* is  $2n = 114$ . All populations of ssp. *dodgeana* which I have seen are on limestone and most herbarium specimens from our region indicate the same habitat. I have not seen ssp. *dodgeana* in Canada or Alaska. Subspecies *rotundifolia* was not on limestone. More study is desirable.

VII. Section *Glaucæ* Pax in Eng. & Prantl, Nat. Pflanzenf. III, **1**: 37. 1887. TYPE SPECIES: *S. glauca* L.

17. ***Salix pedicellaris*** Pursh, Fl. Am. Sept. 611. 1814. TYPE: Catskill Mountains, New York, *Pursh*.



Shrub to 12 dm high; leaf blades oblanceolate, oblong, or narrowly obovate, 1.5–6 cm long, obtuse or rounded at tip, rarely acute, entire, usually glaucous beneath, glabrous; stamens 2; anthers 0.2–0.6 mm long; pistillate aments appearing with the leaves, 1–3 cm long, with leafy floriferous branchlets 0.8–4 cm long; capsules glabrous; stipes 2–4 mm long; styles 0–0.4 mm long; bracts yellowish, brown, or reddish, glabrous or sparsely pubescent, persistent.  $2n = 38, 57, 76$ .

Bogs and swamps in northern Idaho. General distribution: southeast Yukon to Newfoundland south to Oregon, Iowa, and New Jersey.

The rounded, leathery-appearing, glabrous leaves are quite distinctive for recognizing this species.

18. **Salix brachycarpa** Nutt., N. Am. Sylva 1: 69. 1842. TYPE: Beer Springs (Soda Springs), Idaho, *Nuttall s. n.* (Holotype, BM; isotype, GH!).

Shrub to 1.5 m high; leaf blades elliptic to elliptic-obovate or oblong, 0.5–4 cm long, usually pubescent, mostly lighter beneath, entire; stamens 2; anthers 0.2–0.6 mm long; pistillate aments appearing with the leaves, 0.5–2 cm long, usually with leafy floriferous branchlets 2–10 mm long; capsules pubescent; stipes less than 0.5 mm long; styles 0.1–1 mm long; bracts yellow or brown, pubescent, persistent.  $2n = 38$ .

Meadows, slopes, and bogs in or near the mountains in Montana, Wyoming, Idaho, Utah, and Colorado. Additional distribution: Alaska, Canada, Washington, Oregon, and California.

This species is treated in detail by Argus (1965). There seems to be some intergrading of this species with the next, but it may simply reflect a greater range of variability than would be desirable for easy identification.

19. **Salix glauca** L., Sp. Pl. 1019. 1753. TYPE: None designated, *Alpibus Lapponicis & Pyrenaicis* cited.

*Salix pseudolapponum* von Seemen, Engl. Bot. Jahrb. 29(65): 28. 1900. TYPE: Mt. Hesperus, Colorado, *Baker, Earle, & Tracy 300<sup>1</sup>/<sub>2</sub> (Isotypes, A! GH! RM!).*

*Salix wolfii* var. *pseudolapponum* (von Seemen) Jones, Willow Fam. Gt. Plateau 17. 1908.



- Salix glauca* var. *pseudolapponum* (von Seemen) Kelso, Biol. Leafl. **34**: 10. 1946.  
*Salix wyomingensis* Rydb., Bull. Torrey Bot. Club **28**: 271. 1901. TYPE: Big Horn Mountains, Wyoming, *Tweedy 3434* (Holotype, NY; isotype, RM!).  
*Salix pseudolapponum* var. *subincurva* E. H. Kelso, Rhodora **36**: 195. 1934. TYPE: Rocky Mountain National Park, Colorado, *L. Kelso 3503*.  
*Salix glauca* var. *subincurva* (E. H. Kelso) L. Kelso, Biol. Leafl. **34**: 10. 1946.  
*Salix pseudolapponum* var. *kenosha* L. Kelso, Biol. Leafl. **25**: 3. 1944. TYPE: Kenosha Pass, Colorado, *L. & E. H. Kelso 534*.  
*Salix glauca* var. *kenosha* (L. Kelso) L. Kelso, Biol. Leafl. **34**: 10. 1946.

Shrub to 1.5 m high; leaf blades mostly elliptic to elliptic-obovate, 1.5–7 cm long, entire or nearly so, usually glaucescent beneath, pubescent to sometimes glabrous; stamens 2; anthers 0.5–1 mm long; pistillate aments appearing with the leaves, (1.5)2–5 cm long, with leafy floriferous branchlets 5–25 mm long; capsules pubescent; stipes 0–1.5 mm long; styles 0.3–1.5 mm long; bracts brown or black, pubescent, persistent.  $2n = 76-176$ .

Alpine or subalpine in Montana, Wyoming, eastern Idaho, Colorado, northern New Mexico, and Utah. Additional distribution: Eurasia, Alaska, Canada, Greenland, and Iceland.

This species is treated in detail by Argus (1965). In the Rocky Mountains there appear to be two phases of this species (Argus recognizes only one), which may be the result of habitat differences. Taller, upright plants grow at subalpine, often somewhat sheltered locations. Semi-prostrate plants that are often difficult to distinguish from *Salix arctica* grow in more exposed, almost alpine situations. In the field, both phases appear different from plants of Alaska and northern Canada. The status of these populations is still difficult to determine as there is considerable variation within each.

20. ***Salix arctica*** Pallas, Fl. Ross. **1**(2): 86. 1789. TYPE: northern Siberia, *Sujef*.

- Salix petrophila* Rydb., Bull. N. Y. Bot. Gard. **1**: 268. 1899. Based on *S. arctica*  $\delta$  *petraea* Anderss. in DC., Prodr. **16**(2): 287. 1868. TYPE: Rocky Mountains of Canada, *Bourgeau* in 1858 ( $\kappa$ ).  
*Salix caespitosa* Kennedy, Muhlenbergia **7**: 135. 1912. TYPE: Mt. Rose, Washoe Co., Nevada, *Kennedy 1173*.

Creeping shrub to 8 cm high; leaf blades elliptic to oval or rarely obovate, 0.7–3 cm long, obtuse or sometimes acute at tip, usually glaucous beneath, entire, glabrous or not; stamens 2; anthers 0.4–1 mm long; pistillate aments appearing with or after the leaves, 1–5



cm long, on leafy floriferous branchlets 5–35 mm long; capsules pubescent; stipes 0.5 mm or less long; styles 0.5–2 mm long; bracts brown or black, pubescent, persistent.  $2n = 76, 114, \text{ca. } 120$ .

Alpine or subalpine throughout the region except for Arizona and South Dakota. Additional distribution: Eurasia, Alaska, Canada, Greenland, Iceland, Washington, Oregon, and California.

The plants referred here form a very complex group which must be studied world-wide before the relationships can be understood. Rocky Mountain populations are fairly uniform when compared to populations around the world. Depauperate specimens of *Salix glauca* are often difficult to distinguish from *S. arctica*.

21. ***Salix cascadensis*** Cockerell, *Muhlenbergia* 3: 9. 1907. Based on *S. tenera* Anderss. in DC., *Prodr.* 16(2): 288. 1868, not A. Br. ex Unger in 1850. TYPE: Cascade Mountains, 49°, *Lyall* in 1860 (Holotype, K; isotype, GH!).

Creeping shrub to 4 cm high; leaf blades mostly elliptic, 3–20 mm long, entire, glabrous except when very young; stamens 2; anthers 0.2–0.7 mm long; pistillate aments appearing with the leaves, 6–20 mm long, with leafy floriferous branchlets 2–20 mm long; capsules pubescent; stipes 0.5 mm or less long; styles 0.3–1.2 mm long; bracts brown or black, usually pubescent, persistent.

Alpine or subalpine in widely scattered localities of Wyoming, Utah, Montana, and reported from Colorado. Additional distribution: British Columbia and Washington.

The flavonoid profiles of *Salix arctica* and *S. cascadensis* from the Medicine Bow Mountains of southeast Wyoming appear identical. However, the two species grow side by side here with no evidence of hybridization.

VIII. Section *Vetrix* Dumortier, *Bijdr. Natuurk. Wetensch.* 1(1): 55. 1825. TYPE SPECIES: *S. caprea* L.

22. ***Salix bebbiana*** Sarg., *Gard. & Forest* 8: 463. 1895. Based on *S. rostrata* Richards. in Frankl., *Narr. 1st Journ.* 753. 1823, not Thuill. in 1799. TYPE: None designated, localities in Canada cited (K).

*S. perrostrata* Rydb. in Britt. & Rydb., *Bull. N. Y. Bot. Gard.* 2: 163. 1901. TYPE: near Hermosa, Black Hills of South Dakota, *Rydberg 1018*.



Shrub or sometimes tree-like to 7 m high; leaf blades elliptic or elliptic-obovate, 1–7 cm long, usually glaucous and pubescent at least beneath, entire or rarely slightly toothed; stamens 2; anthers 0.4–0.8 mm long; pistillate aments appearing with the leaves, 1.5–6 cm long, sessile or with leafy floriferous branchlets to 15 mm long; capsules pubescent; stipes mostly 2–5 mm long; styles 0.4 mm or less long; bracts brown or yellowish, usually pubescent, persistent.  $2n = 38$ .

Woods, meadows, and swamps throughout the region. General distribution: Eurasia; Alaska and Canada south to California, New Mexico, Indiana, and New Jersey.

This is a very common species readily recognized by the reddish-purple, appressed-hairy branchlets and bud scales with depressed margins.

23. ***Salix petiolaris*** Smith, Trans. Linn. Soc. London **6**: 122. 1802.

TYPE: reputedly from Britain but cultivated from America, *Dickson*.

Shrub to 7 m high; leaf blades narrowly lanceolate, oblanceolate, or elliptic, 2–10 cm long, acute or acuminate, serrate to subentire, glaucous beneath, glabrous when mature; stamens 2; anthers 0.5–0.8 mm long; pistillate aments appearing with the leaves, 1–3.5 cm long, sessile or with leafy floriferous branchlets to 2 cm long; capsules usually thinly pubescent; stipes 1–4 mm long; styles 0.1–0.3 mm long; bracts brown, pubescent, persistent.  $2n = 38$ .

Meadows, shores, and stream banks. Very local in South Dakota, Colorado, and reported from Montana. General distribution: New Brunswick to Alberta south to New Jersey and Colorado; outliers in Oklahoma, Virginia, and Georgia.

24. ***Salix geyeriana*** Anderss., Proc. Am. Acad. Arts **4**: 63. 1858.

TYPE: Coeur d'Alene River, Idaho [Geyer, London Jour. Bot. **5**: 289, 1846] *Geyer* 286 (Holotype, K; fragment A!).

*Salix macrocarpa* Nutt., N. Am. Sylva **1**: 67. 1842, not Ledeb. ex Trautv. in 1832.

TYPE: *Nuttall*, Oregon?

Shrub to 7 m high; twigs usually pruinose; leaf blades elliptic or nearly so, 1–8 cm long, entire or nearly so, often lighter beneath, usually pubescent; stamens 2; anthers 0.3–0.7 mm long; pistillate aments appearing with the leaves, 8–20(25) mm long,



with usually leafy floriferous branchlets 2–12(18) mm long; capsules pubescent; stipes 1–3 mm long; styles less than 0.8 mm long; bracts yellow or brown to sometimes black, pubescent, persistent.  $2n = 38$ .

Wet places throughout the region except New Mexico. General distribution: southern British Columbia and Montana south to California, Colorado, and western Nebraska.

*Salix geyeriana* usually has white-sericeous leaves which are obscurely glaucous. The bracts are often light in color and somewhat narrow. The leaves of *S. lemmonii* are usually distinctly glaucous beneath with few hairs, some of which are red. The bracts are usually black and broader. However, I have not been able to find a combination of morphological characteristics that will always separate the two species. The flavonoid profiles of the two species are distinctly different. The type of *S. geyeriana* may be what is now called *S. lemmonii*. Further study is needed.

25. **Salix lemmonii** Bebb in Wats., Bot. Calif. 2: 88. 1879. TYPE: Sierra Co., California, *Lemmon s. n.* (Lectotype by Schneider 1920c, F; isoelectotype, GH!).

Shrub to 5 m high; branchlets often pruinose; leaf blades oblanceolate or elliptic, 2–10 cm long, acute or acuminate, entire or rarely serrulate, glaucescent or glaucous beneath, glabrous or puberulent; stamens 2; anthers 0.4–0.7 mm long; pistillate aments appearing with or sometimes before the leaves, 1–4 cm long, sessile or with leafy floriferous branchlets to 1 cm long; capsules pubescent; stipes 0.5–2 mm long; styles 0.2–0.7 mm long; bracts brown or black, pubescent, persistent.  $2n = \text{ca. } 76$ .

Stream banks and wet meadows in Idaho, Montana, Wyoming, Colorado, and Nevada. Additional distribution: California and Oregon.

See discussion under *Salix geyeriana*.

26. **Salix discolor** Muhl., Neue Schriften Ges. Berlin 4: 234. 1803. TYPE: Lancaster, Pennsylvania, *Muhlenberg s. n.* (Holotype, PH!).

Shrub to 7 m high; leaf blades mostly elliptic or oblanceolate, 3–12 cm long, usually somewhat wavy-toothed, glaucous beneath, glabrous, or pubescent beneath with often reddish hairs; stamens



2; anthers 0.5–0.9 mm long; pistillate aments appearing before the leaves, 2–7 cm long, sessile or nearly so; capsules pubescent; stipes 1–3 mm long; styles 0.3–1.2 mm long; bracts dark brown or black, pubescent, persistent.  $2n = 76, 114$ .

Wet places in widely scattered localities of South Dakota, northeast Wyoming, Montana, and Idaho. General distribution: Newfoundland to British Columbia south to Delaware, Missouri, and Idaho.

27. **Salix scouleriana** Barratt ex Hook., Fl. Bor. Am. 2: 145. 1838.

TYPE: Columbia River, *Scouler* in 1825 (Holotype, K; fragment A!).

*Salix flavescens* Nutt., N. Am. Sylva 1: 65. 1842, not Host in 1828. TYPE: Rocky Mountains, *Nuttall s. n.* (Isotype, GH!).

*Salix nuttallii* Sarg., Gard. & Forest 8: 463. 1895. Based on *S. flavescens* Nutt.

Shrub or tree to 15 m high; leaf blades mostly obovate or oblanceolate, 2–10 cm long, entire or sometimes toothed, glaucous beneath, glabrous or pubescent beneath; stamens 2; anthers 0.7–1.1 mm long; pistillate aments appearing before or sometimes with the leaves, 1.5–7 cm long, sessile or with floriferous branchlets to 13 mm long; capsules pubescent; stipes 0.8–2.8 mm long; styles 0.2–1.1 mm long; bracts dark brown or black, pubescent, persistent.  $2n = 76$ .

Woods, clearings, or occasionally on shores throughout the region. General distribution: Alaska to District of Mackenzie (Manitoba?) south to California and New Mexico.

This species is common in drier upland habitats and is readily recognized by the obovate to oblanceolate leaves. The flavonoid profile of the species appears identical to that of *Salix humilis* Marsh. Further study might show that rearrangements are necessary in this group.

IX. Section *Vimen* Dumortier, Bijdr. Natuurk. Wetensch. 1(1): 56. 1825. TYPE: *S. viminalis* L.

28. **Salix planifolia** Pursh, Fl. Am. Sept. 611. 1814. TYPE: None designated, description from Labrador plants in garden of George Anderson.



*Salix nelsonii* Ball, Bot. Gaz. **40**: 379. 1905. TYPE: Laramie Peak, Albany Co., Wyoming, *Nelson 7580* (Holotype, US; isotype, RM!).

Shrub to 5 m high; leaf blades mostly elliptic, 1–8 cm long, entire or sometimes toothed, glaucous beneath, glabrous or slightly pubescent beneath; stamens 2; anthers 0.5–1 mm long; pistillate aments appearing before or sometimes with the leaves, 1.5–6 cm long, sessile or subsessile; capsules pubescent; stipes 0–1 mm long; styles 0.4–1.5 mm long; bracts black or sometimes brown, pubescent, persistent.  $2n = 57, 76, 152$ .

Mostly subalpine in wet places but occasional in the lower mountains in Idaho, Montana, Wyoming, South Dakota, Colorado, Utah, northern New Mexico, and northeast Nevada. General distribution of subspecies *planifolia*: Yukon to Labrador south to California, New Mexico, northern Minnesota, and New Hampshire.

The branchlets of this species are often bright red.

29. ***Salix drummondiana*** Barratt ex Hook., Fl. Bor. Am. **2**: 144. 1838. TYPE: Rocky Mountains of Canada, *Drummond 672* (Lectotype by Argus 1973, K; fragment A).

*Salix pachnophora* Rydb., Bull. Torrey Bot. Club **31**: 403. 1904. TYPE: Chambers Lake, Colorado, *Agr. Coll. of Colorado* in 1899 (NY).

Shrub to 6 m high; twigs usually pruinose; leaf blades elliptic, oblong, or oblanceolate, rarely obovate, 1.5–11 cm long, entire or nearly so, silvery-hairy beneath, green and glabrous or glabrate above; stamens 2; anthers 0.3–0.6 mm long; pistillate aments appearing before or with the leaves, 1.5–6 cm long, sessile or nearly so; capsules pubescent; stipes 0.1–0.8 mm long; styles 0.5–1.8 mm long; bracts brown or black, pubescent, persistent.  $2n = 38, 57, 76$ .

Stream banks and swamps mostly in the mountains throughout the region except Arizona. General distribution: southeast Yukon to Saskatchewan south to California and New Mexico.

My chromosome count of  $2n = 38$  is for a plant with oblong-lanceolate leaves that are densely silver-pubescent beneath. My counts of  $2n = 76$  are from plants with broader leaves that are less pubescent beneath. These forms may represent different species. The former matches the description of the lectotype of *Salix*



*drummondiana*. The latter may correspond to *S. pachnophora*. The flavonoid profiles of the two forms appear identical, yet more study is needed. This species is often confused with *S. geyeriana* and *S. lemmonii*, but the closely flowered pistillate aments and silvery-pubescent lower leaf surface readily distinguish it from the two species which have loosely flowered aments.

30. **Salix candida** Flügge ex Willd., Sp. Pl. 4: 708. 1806. TYPE: none designated, specimen from Willdenow Herbarium seen on microfiche.

Shrub to 1.5 m high; leaf blades elliptic or oblong or sometimes oblanceolate, 1–9 cm long, white-tomentose beneath, less pubescent or glabrate above, entire or nearly so; stamens 2; anthers 0.3–0.6 mm long; pistillate aments appearing before or with the leaves, 1–6 cm long, sessile or with leafy floriferous branchlets to 9 mm long; capsules pubescent; stipes less than 1 mm long; styles 0.2–1.7 mm long; bracts brown or yellowish, rarely black, pubescent, persistent.  $2n = 38$ .

Bogs. Very local in Fremont Co., Idaho, Montana, Wyoming, South Dakota, and northern Colorado. General distribution: Alaska and Canada south to northern Colorado, Iowa, and New Jersey.

This species is easily recognized by the densely white-tomentose lower leaf surface.

X. Section *Brewerianae* Schneider, Jour. Arnold Arb. 1: 95. 1919. TYPE SPECIES: *S. breweri* Bebb.

31. **Salix irrorata** Anderss., Proc. Am. Acad. Arts 4: 57. 1858. TYPE: Santa Fe, New Mexico, *Fendler 812*.

Shrub to 5 m high; branchlets usually pruinose; leaf blades oblong-elliptic or oblanceolate, 2–10 cm long, acute or obtuse at tip, entire or obscurely toothed, glaucescent beneath, glabrous when mature; stamens 2; anthers 0.4–0.6 mm long; pistillate aments usually appearing before the leaves, 2–4 cm long, sessile or nearly so; capsules glabrous; stipes 0.3–1 mm long; styles 0.2–0.7 mm long; bracts brown or black, pubescent, persistent.



Stream banks in Colorado, New Mexico, and Arizona. Additional distribution: southwest Texas.

32. ***Salix lasiolepis*** Benth., Pl. Hartw. 335. 1857. TYPE: near Monterey, California, *Hartweg s. n.* (Holotype, K; isotype, GH!).

*Salix boiseana* A. Nels., Bot. Gaz. 54: 406. 1912. TYPE: near Boise, Idaho, *Clark 48* (Holotype, RM!).

*Salix sandbergii* Rydb., Bull. Torrey Bot. Club 39: 304. 1912. TYPE: Valley of Hatwai Creek, Idaho, *Sandberg, MacDougal, & Heller 71* (Holotype, NY; isotypes, A! GH!).

Shrub or tree to 12 m high; leaf blades oblanceolate or oblong or sometimes obovate, 2–12 cm long, acute to obtuse at tip, entire or nearly so, glaucous beneath, pubescent or glabrous; stamens 2; anthers 0.4–0.8 mm long; pistillate aments appearing before or with the leaves, 2–6 cm long, sessile; capsules glabrous; stipes 0.5–2 mm long; styles 0.1–0.6 mm long; bracts black or brown, pubescent, persistent.  $2n = 38$ .

Stream banks in southwest Idaho, Nevada, Arizona, southern Utah, and New Mexico. Additional distribution: southern Washington, Oregon, California, southwest Texas, and northern Mexico.

XI. Section *Cordatae* Barratt ex Hook., Fl. Bor. Am. 2: 149. 1838. TYPE SPECIES: *S. rigida* Muhl.

Many species of this section are treated in more detail elsewhere (Dorn, 1975a). The 13 species treated here all have different flavonoid profiles. Compounds were identified for eight of the 13 species. Three polyploid levels are known in the section.

33. ***Salix pseudomonticola*** Ball in Standley, Contr. U. S. Natl. Herb. 22: 321. 1921. TYPE: Rocky Mountains Park, Alberta, *Sanson 233* (Lectotype by Ball, 1923, US!).

*Salix barclayi* var. *pseudomonticola* (Ball) Kelso, Biol. Leaflet 34: 8. 1946.

Shrub to 6 m high; leaf blades elliptic to ovate or obovate, 2.5–10 cm long, crenate-serrate, glaucous beneath, glabrous except when young, the young usually reddish; stamens 2; anthers 0.4–0.6 mm long; pistillate aments usually appearing before the leaves, 1–9 cm long, sessile or with sometimes leafy floriferous branchlets to 7(12) mm long; capsules glabrous; stipes 0.5–2.5(3) mm long;



styles (0.5)0.7–1.8 mm long; bracts brown or black, pubescent, persistent.  $2n = 38$ .

Stream banks, swamps, and wet meadows in the mountains of eastern Idaho, Montana, northern Wyoming, and South Dakota. Additional distribution: Alaska and Canada east to northwest Quebec.

This species is best recognized by the sessile or subsessile precocious aments with glabrous pistils and the reddish young leaves.

34. ***Salix farriæ*** Ball in Standley, Contr. U. S. Natl. Herb. **22**: 321. 1921. TYPE: Field, British Columbia, *Farr 558* (Lectotype by Ball, 1934, US!).

*Salix hastata* var. *farriæ* (Ball) Hultén, Ark. Bot. **7**(1): 42. 1968.

*Salix farriæ* var. *microserrulata* Ball, Univ. Calif. Publ. Bot. **17**: 410. 1934.

TYPE: near Banff, Alberta, *Malte & Watson 898* (Holotype, US!).

Shrub to 1.5(2) m high; leaf blades elliptic to elliptic-obovate, 2–7 cm long, entire or occasionally serrulate, glaucous beneath, glabrous; stamens 2; anthers 0.3–0.6 mm long; pistillate aments appearing with the leaves, 1–4.5 cm long, with leafy floriferous branchlets (3)5–15 mm long; capsules glabrous; stipes 0.3–1.5(2) mm long; styles 0.3–1.2 mm long; bracts yellow or green to brown or black, pubescent to glabrous, persistent.

Meadows and stream banks in the mountains of Idaho, Montana, and northwest Wyoming. Additional distribution: Alberta, British Columbia, and northeast Oregon.

This species is best recognized by the usually entire, glabrous, pale green leaves with a distinctive venation on the glaucous surface.

35. ***Salix barclayi*** Anderss., Proc. Am. Acad. Arts **4**: 66. 1858. TYPE: Kodiak Island, Alaska, *Barclay s. n.* (Holotype, K!).

*Salix conjuncta* Bebb, Bot. Gaz. **13**: 111. 1888. TYPE: Mt. Adams, Washington, *Parry* in 1880 (Lectotype by Dorn, 1975a, F!).

*Salix barclayi* var. *conjuncta* (Bebb) Ball ex Schneider, Jour. Arnold Arb. **1**: 151. 1920: **3**: 73. 1922.

Shrub to 2 m high; leaf blades ovate-elliptic or narrowly elliptic to obovate, 2.5–9 cm long, serrate or rarely entire, glaucous beneath, often pubescent above especially when young; stamens 2; anthers 0.5–1 mm long; pistillate aments appearing with the leaves,



1–6 cm long, with leafy floriferous branchlets (0.5)1–3 cm long; capsules glabrous; stipes 0.5–1.5(2) mm long; styles (0.5)0.7–2.5 mm long; bracts brown or black, pubescent, persistent.  $2n = 76$ .

Mountain slopes, stream banks, and swamps in northwest Wyoming, Montana, and Idaho. General distribution: Alaska to District of Mackenzie south to Washington and northwest Wyoming.

36. ***Salix commutata*** Bebb, Bot. Gaz. **13**: 110. 1888. TYPE: Eagle Creek Mts., Oregon, *Cusick* 826 (Lectotype by Dorn, 1975a, F!).

*Salix barclayi* var. *commutata* (Bebb) Kelso, Biol. Leaflet. **34**: 8. 1946.

*Salix commutata* var. *sericea* Bebb, Bot. Gaz. **13**: 111. 1888. TYPE: Mt. Hood, Oregon, *Howell s. n.* (Lectotype by Dorn, 1975a, F!).

*Salix commutata* var. *mixta* Piper, Contr. U. S. Natl. Herb. **11**: 216. 1906. Based on *S. commutata* var. *sericea* Bebb.

*Salix commutata* var. *denudata* Bebb, Bot. Gaz. **13**: 111. 1888. TYPE: Eagle Creek Meadows, Oregon, *Cusick* 968 (Lectotype by Dorn, 1975a, F!).

*Salix commutata* var. *puberula* Bebb, Bot. Gaz. **13**: 111. 1888. TYPE: Oregon, *Cusick* sheet 7745 (Lectotype by Dorn, 1975a, F!).

Shrub to 3 m high; leaf blades elliptic or oval to ovate or obovate, the larger (1)3–7(9) cm long, (0.5)1.5–3(4) cm wide, entire or glandular-toothed, not glaucous, densely pubescent with long hairs when young, often becoming glabrate later; stamens 2; anthers 0.4–1 mm long; pistillate aments appearing with the leaves, (2)3–7(10) cm long including the floriferous branchlet, the latter 8–30 mm long and leafy; capsules glabrous or rarely puberulent; stipes (0.3)0.8–2 mm long; styles 0.5–1.5 mm long; bracts light brown or yellowish to black, pubescent, persistent.  $2n = 38$ .

Moist meadows and stream banks, usually subalpine, in Idaho and western Montana. General distribution: Alaska to District of Mackenzie south to northern Oregon and western Montana.

37. ***Salix wolfii*** Bebb in Rothr., Bot. Wheeler Exp. 241. 1878. TYPE: South Park, Colorado, *Wolf & Rothrock* 820 (Lectotype by Schneider, 1920b, F; isolectotype, GH!).

*Salix wolfii* var. *idahoensis* Ball, Bot. Gaz. **40**: 378. 1905. TYPE: Forks of Wood River, Idaho, *Henderson* 3399 (US).

*Salix idahoensis* (Ball) Rydb., Fl. Rocky Mts. 197, 1061. 1917.

Shrub to 2 m high; leaf blades mostly elliptic, lanceolate, or oblanceolate, 1–6 cm long, entire, not glaucous, pubescent; stamens 2; anthers 0.3–0.7 mm long; pistillate aments appearing with



the leaves, 8–20 mm long, subsessile or with leafy floriferous branchlets to 12 mm long; capsules glabrous or pubescent; stipes 0–0.8 mm long; styles 0.2–1.3 mm long; bracts brown or black, pubescent, persistent.  $2n = 38$ .

Wet places in the mountains of Colorado, Utah, Nevada, Wyoming, Idaho, and southern and central Montana. Additional distribution: northeast Oregon.

This species is normally less than 1 meter high but occasionally reaches 2 meters. The short aments and sericeous leaves are distinctive.

38. ***Salix orestera*** Schneider, Jour. Arnold Arb. **1**: 164. 1920.

TYPE: Mt. Goddard, Fresno Co., California, *Hall & Chandler 695* (Isotype, NY!).

*Salix glauca* ssp. *orestera* (Schneider) Youngb., Madroño **21**: 124. 1971.

Shrub to 3 m high; leaf blades oblanceolate or elliptic, 2–8 cm long, acute, entire, glaucescent beneath or sometimes green on both sides, pubescent; stamens 2; anthers 0.6–1.1 mm long; pistillate aments appearing with the leaves, 1–4 cm long, with leafy floriferous branchlets 3–15(25) mm long; capsules pubescent; stipes 0.5–2 mm long; styles 0.5–1.5 mm long; bracts brown or black, pubescent, persistent.

Stream banks and wet meadows in the mountains of western Nevada. Additional distribution: California.

39. ***Salix eastwoodiae*** Cockerell ex Heller, Cat. N. Am. Pl. **3**: 89.

1910. Based on *S. californica* Bebb in Wats., Bot. Calif. **2**: 89. 1879, not Lesq. in 1878. TYPE: Sierra Nevada, California, *Lemmon s. n.* (Lectotype by Schneider 1920a, F!).

*Salix commutata* var. *rubicunda* Jepson, Man. Fl. Pl. Calif. 267. 1923. TYPE: Head of Lost Creek, Sawtooth Range, Tulare Co., California, *Jepson 4992* (Holotype, JEPS; isotype, A!).

Shrub to 4 m high; leaf blades lanceolate to elliptic or oblanceolate, rarely broader, 2–6(10) cm long, the margins prominently glandular at least when young, not glaucous, pubescent at least when young; stamens 2; anthers 0.3–1 mm long; pistillate aments appearing with or slightly before the leaves, 1–5 cm long, with leafy floriferous branchlets 3–12(20) mm long; capsules pubescent;



stipes 0.2–1.8 mm long; styles 0.4–1.5 mm long; bracts brown or black, pubescent, persistent.  $2n = \text{ca. } 76$ .

Wet meadows and stream banks well up in the mountains of western Nevada, Idaho, western Wyoming, and southwest Montana. Additional distribution: California and Oregon.

The glands on the margins of young leaves or on leaves of floriferous branchlets are distinctive by being largely set out from the margin and oriented at a right angle to the margin. They are often rather crowded.

40. ***Salix boothii*** Dorn, Can. Jour. Bot. 53: 1505. 1975. TYPE: Tributary to Pacific Creek, Teton Co., Wyoming, *Dorn 1288* (Holotype, RM!).

*Salix myrtilifolia* of authors, not Andersss.

*Salix pseudomyrsinites* of authors, not Andersss.

*Salix curtiflora* of authors, not Andersss.

*Salix myrtilifolia* var. *curtiflora* (Andersss.) Bebb ex Rose, Contr. U. S. Natl. Herb. 3: 573. 1896. Misapplied.

*Salix novae-angliae* of authors, not Andersss.

*Salix pseudocordata* (Andersss.) Rydb., Fl. Colorado 94. 1906. Misapplied.

*Salix novae-angliae* l. *S. pseudo-myrsinites* (Andersss.) Andersss. c. *aequalis* Andersss., Kongl. Svenska Vetenskapsakad. Handl. 6(1): 161. 1867. TYPE: Rocky Mountains of Alberta, *Bourgeau s. n.* (Holotype, K!).

*Salix pseudomyrsinites* var. *aequalis* (Andersss.) Andersss. ex Ball in Coult. & Nels., New Man. Rocky Mts. 133. 1909.

*Salix pseudocordata* var. *aequalis* (Andersss.) Ball ex Schneider, Jour. Arnold Arb. 2: 196; 3: 73. 1922.

Shrub to 6 m high; leaf blades lanceolate to elliptic or oblanceolate or rarely lance-ovate, the larger (1)2–8(10) cm long, (0.4)0.8–2.5 cm wide, serrate to entire, not glaucous, pubescent at least when young, often becoming glabrous; stamens 2; anthers 0.3–0.7 mm long; pistillate aments appearing with or slightly before the leaves, (1)2–5 cm long, the floriferous branchlets (1)2–10(15) mm long and usually leafy; capsules glabrous; stipes 0.5–2(2.5) mm long; styles 0.3–1.2(1.5) mm long; bracts brown to black, pubescent or rarely glabrous, persistent.  $2n = 76$ .

Stream banks and swamps from sagebrush plains near the mountains to near subalpine in Idaho, Montana, Wyoming, Colorado, Nevada, and Utah. Additional distribution: northeast California, northeast Oregon, southern British Columbia, and southern Alberta.



41. **Salix arizonica** Dorn, Can. Jour. Bot. **53**: 1499. 1975. TYPE: T7N, R27E NW¼ Sec 18, 9100 ft., Apache Co., Arizona, *Granfelt 69-191* (Holotype, ARIZ!).

Shrub at least 0.5 m high; leaves ovate, broadly elliptic, or obovate, 1–4.5 cm long, 5–22 mm wide, serrulate, not glaucous, glabrous or nearly so or the younger pubescent; stamens 2; anthers 0.3–0.6 mm long; pistillate aments appearing with or slightly before the leaves, 1–4 cm long, the floriferous branchlets 3–12 mm long and leafy; capsules glabrous; stipes 0.2–1.5 mm long; styles 0.6–1.5 mm long; bracts brown to rarely black, pubescent, persistent.

Wet meadows and stream banks. Endemic in the White Mountains of Arizona.

All known collections of this species are within 10 miles of each other.

42. **Salix monticola** Bebb in Coult., Man. Rocky Mt. Reg. 336. 1885. TYPE: near Golden, Colorado, *Greene 8* (Lectotype by Dorn 1975a, F!).

*Salix cordata* var. *monticola* (Bebb) Kelso, Biol. Leafl. **34**: 7. 1946.

*Salix padifolia* Rydb., Bull. Torrey Bot. Club **28**: 272. 1901, not Anders. in 1858. TYPE: Tributaries of Turkey Creek, Colorado, *Rydberg & Vreeland 6389* (Holotype, NY!).

*Salix padophylla* Rydb., Bull. Torrey Bot. Club **28**: 499. 1901. Based on *S. padifolia* Rydb.

*Salix pseudomonticola* var. *padophylla* (Rydb.) Ball, Jour. Wash. Acad. Sci. **28**: 450. 1938.

*Salix barclayi* var. *padophylla* (Rydb.) Kelso, Biol. Leafl. **34**: 8. 1946.

*Salix barclayi* var. *veritomonticola* Kelso, Biol. Leafl. **34**: 8. 1946. TYPE: Leadville, Colorado, *Kelso 6173* (Neotype by Dorn 1975a, RM!).

*Salix barclayi* var. *cochetopiana* Kelso, Biol. Leafl. **34**: 8. 1946. TYPE: Leadville, Colorado, *L. & E. H. Kelso 5575* (Neotype by Dorn 1975a, RM!).

*Salix sawatchicola* Kelso, Biol. Leafl. **34**: 9. 1946. TYPE: Leadville, Colorado, *Kelso 4872* (Holotype, RM!).

*Salix amelanchieroides* Kelso, Biol. Leafl. **34**: 9. 1946. TYPE: Leadville, Colorado, *Kelso 5419* (Holotype, GH!).

*Salix barclayi* var. *resurrectionis* Kelso, Biol. Leafl. **36**: 2. 1947. TYPE: Leadville, Colorado, *Kelso 5519* (Holotype, RM!).

*Salix barclayi* var. *uncompahgre* Kelso, Biol. Leafl. **37**: 4. 1947. TYPE: Sneffels Creek, Ouray, Colorado, *Kelso 5673* (Holotype, RM!).

*Salix dissymmetrica* Kelso, Biol. Leafl. **61**: 3. 1952. TYPE: Leadville, Colorado, *Kelso 6426* (Holotype, CAN!).



Shrub to 5 m high; leaf blades ovate to obovate, 2–8 cm long, crenate or serrate, rarely subentire, glaucous beneath, glabrous, or pubescent when young; stamens 2; anthers 0.4–0.9 mm long; pistillate aments appearing before or with the leaves, 1–6 cm long, sessile or with leafy floriferous branchlets to 8(17) mm long; capsules usually glabrous; stipes 0.3–1.5(2) mm long; styles 0.7–1.8 mm long; bracts brown or black, pubescent, persistent.  $2n = 114$ .

Stream banks and wet meadows from the plains near the mountains to subalpine. Known only from southern Wyoming, Colorado, Utah, Arizona, and New Mexico.

43. ***Salix lutea*** Nutt., N. Am. Sylva 1: 63. 1842. TYPE: Rocky Mountains to banks of the Oregon, *Nuttall*.

*Salix flava* Rydb., Bull. Torrey Bot. Club 28: 273. 1901, not Gmel. in 1791. TYPE: Green River, Wyoming, *Rydberg* in 1895 (NY).

*Salix cordata* var. *watsonii* Bebb in Wats., Bot. Calif. 2: 86. 1879. TYPE: Syntypes from Nevada and California (F).

*Salix watsonii* (Bebb) Rydb., Bull. Torrey Bot. Club 33: 137. 1906.

Shrub to 6 m high; leaf blades mostly lanceolate or nearly so, 1.5–11 cm long, toothed or sometimes entire, glaucous beneath, glabrous except when young; stamens 2; anthers 0.4–0.8 mm long; pistillate aments appearing before or with the leaves, 2–6 cm long, sessile or with leafy floriferous branchlets to 15 mm long; capsules glabrous; stipes (1)2–4.5 mm long; styles 0.2–0.7(0.8) mm long; bracts brown or black, usually glabrous or glabrate, persistent.  $2n = 38$ .

Wet places throughout the region except possibly not in Arizona or New Mexico. General distribution: Washington and Alberta to Manitoba south to California and at least to Nebraska and Colorado.

A distinguishing feature for this species is the silvery-gray bark on the older twigs. The staminate aments are also distinctive in appearance, but they are difficult to describe. The species was recently considered to be conspecific with *Salix rigida* Muhl., but the two differ in morphology, distribution, and flavonoid chemistry. The flavonoid profiles indicate that *S. rigida* and *S. cordata* Michx. have flavones and flavonols in the leaves while *S. lutea*



and the other related western species probably have only flavonols. *Salix ligulifolia*, *S. mackenzieana*, and *S. monochroma* apparently also have distinct profiles but these are not as obviously different as those between the eastern and western plants. I am uncertain of the geographical limits of these species, and there may be more species than those recognized here. I have not been able to confirm the presence of *S. mackenzieana* in our region. The plants from Idaho south to Arizona and west to the coast are especially confusing. *Salix ormsbyensis* von Seemen is either a hybrid between *S. lutea* and *S. ligulifolia* or the same as the latter species. The group is extremely complex and the problems cannot be resolved without extensive study. In general, *S. ligulifolia* has short stipes and bluish-green leaves, *S. monochroma* has non-glaucous and thin leaves, *S. lutea* has a silvery-gray bark on the older twigs, and *S. mackenzieana* has very long stipes. These are the most apparent morphological characteristics for recognition of the respective species.

44. ***Salix ligulifolia*** Ball ex Schneider, Jour. Arnold Arb. 2: 186, 188. 1922. TYPE: Syntypes from New Mexico, Colorado, Utah, Wyoming, and Nevada.

*Salix lutea* var. *ligulifolia* Ball, Bot. Gaz. 71: 428. 1921. TYPE: above Ft. Apache, Arizona, Coville 1977 (US).

Shrub to 5 m high; leaf blades narrowly elliptic or lanceolate, 1–10 cm long, entire or sometimes toothed, pale or glaucous beneath, glabrous or nearly so; stamens 2; anthers 0.4–0.8 mm long; pistillate aments appearing before or with the leaves, 1.5–6 cm long, sessile or with leafy floriferous branchlets to 10 mm long; capsules glabrous; stipes 1–2 mm long; styles 0.1–0.7 mm long; bracts brownish or black, pubescent, persistent.  $2n = 38$ .

Stream banks in the plains and foothills of Nevada, Arizona, New Mexico, southern Utah, Colorado, and southeast Wyoming. Additional distribution: California and southern Oregon.

See discussion under *S. lutea*.

45. ***Salix monochroma*** Ball, Bot. Gaz. 71: 431. 1921. TYPE: valley of Hatwai Creek, Nez Perces Co., Idaho, Sandberg, MacDougal, & Heller 39 (Lectotype here designated, pistillate specimen, US!).



Shrub to 4 m high; leaf blades ovate or lanceolate to elliptic-obovate, 2–10 cm long, shallowly toothed, not glaucous, glabrous except when young; stamens 2; pistillate aments appearing with the leaves, 2–6 cm long, with usually leafy floriferous branchlets 3–8(13) mm long; capsules glabrous; stipes (1.5)2–4 mm long; styles 0.2–0.7(1) mm long; bracts brown or black, usually pubescent, persistent.

Wet meadows and stream banks in Idaho and possibly northwest Wyoming and western Montana. Additional distribution: Washington, Oregon, and British Columbia.

See discussion under *S. lutea*.

XII. Section *Sitchenses* (Bebb) Schneider, Jour. Arnold Arb. 1: 91. 1919. TYPE SPECIES: *S. sitchensis* Sanson ex Bong.

46. ***Salix sitchensis*** Sanson ex Bong., Mem. Acad. St. Petersburg. VI, 2: 162. 1832. TYPE: Sitka, Alaska, *Mertens* in 1827.

Shrub or tree-like, to 6 m high; leaf blades obovate, oblanceolate, or sometimes elliptic, 2–9 cm long, obtuse or rounded at tip, mostly entire, silvery-hairy beneath; stamens solitary; anthers 0.6–0.8 mm long; pistillate aments appearing before or with the leaves, 2–8 cm long, with leafy floriferous branchlets 5–20 mm long; capsules pubescent; stipes 1 mm or less long; styles 0.3–1 mm long; bracts black or brown, pubescent, persistent.  $2n = 38$ .

Stream banks in northwest Montana, northern Idaho, and western Nevada. Additional distribution: southern Alaska, British Columbia, Washington, Oregon, and California.

This species is often confused with *Salix scouleriana* but the silvery pubescence of the lower leaf surface and the solitary stamens are distinctive.

XIII. Section *Lanatae* Koehne, Deutsche Dendrol. 87. 1893. TYPE SPECIES: *S. lanata* L.

47. ***Salix barrattiana*** Hook., Fl. Bor. Am. 2: 146. 1838. TYPE: Rocky Mountains of Canada, *Drummond* (Holotype, K; fragment A!).



Shrub to 1.5 m high; leaf blades elliptic or sometimes oblanceolate, 2–7 cm long, usually pubescent and entire or minutely serrulate; stamens 2; anthers 0.5–0.8 mm long; pistillate aments appearing before or with the leaves, some usually terminating growth of previous season, 4–9 cm long, usually sessile or nearly so; capsules pubescent; stipes less than 1 mm long; styles 1–2.5 mm long; bracts brown or black, pubescent, persistent.

Alpine and subalpine on the Beartooth Plateau of Montana and Wyoming and in Glacier Park, Montana. Additional distribution: Alaska, Yukon, District of Mackenzie, Alberta, and British Columbia.

The glutinous twigs are very distinctive and stain pressing papers yellow or green.

48. ***Salix tweedyi*** (Bebb ex Rose) Ball, Bot. Gaz. **40**: 377. 1905.

*Salix barrattiana tweedyi* Bebb ex Rose, Contr. U. S. Natl. Herb. **3**: 572. 1896. TYPE: Big Horn Mountains, Wyoming, *Tweedy 11* (Lectotype by Ball 1905, US!).

*Salix rotundifolia* Nutt., N. Am. Sylva **1**: 75. 1842, not Trautv. in 1832. TYPE: Thornburgh's Ravine, Idaho, *Nuttall s. n.* (Isotype, GH!).

Shrub to 4 m high; leaf blades elliptic, ovate, or obovate, 2–10 cm long, finely toothed, often slightly paler beneath, glabrous, or pubescent especially when young; stamens 2; anthers 0.5–0.9 mm long; pistillate aments appearing before or with the leaves, some at tips of twigs of previous year, 3–9 cm long, sessile or with floriferous branchlets to 10 mm long; capsules glabrous; stipes 0.2–1.2 mm long; styles 1–3 mm long; bracts dark brown or black, pubescent, persistent.

Stream banks and wet meadows in the mountains of Wyoming, Montana, and Idaho. Additional distribution: north-central Washington.

This species normally has very long and stout aments, some of which appear terminal on twigs of the previous year. The branchlets often have long, spreading hairs. The species seems to be common only in a few areas such as the Teton Range, Wyoming; the Beartooth Plateau area of Montana and Wyoming; and southern Gallatin and Park Counties, Montana.



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## LITERATURE CITED

- ARGUS, G. W. 1965. The taxonomy of the *Salix glauca* complex in North America. *Contr. Gray Herb.* **196**: 1-142.
- . 1969. New combinations in the *Salix* of Alaska and Yukon. *Can. Jour. Bot.* **47**: 795-801.
- . 1973. The genus *Salix* in Alaska and the Yukon. *Natl. Mus. Canada Publ. Bot. No. 2*. xvi + 279 pp.
- BALL, C. R. 1905. Notes on North American willows. I. *Bot. Gaz.* **40**: 376-380.
- . 1921. Notes on willows of sections *Pentandrae* and *Nigrae*. *Bot. Gaz.* **72**: 220-236.
- . 1923. *Salix*. In: L. ABRAMS, *An illustrated flora of the Pacific States* **1**: 487-507.
- . 1934. New or little known west American willows. *Univ. Calif. Publ. Bot.* **17**: 399-434.
- . 1952. *Salix*. Pp. 216-235 in: R. J. DAVIS, *Flora of Idaho*.
- DORN, R. D. 1975a. A systematic study of *Salix* section *Cordatae* in North America. *Can. Jour. Bot.* **53**: 1491-1522.
- . 1975b. Cytological and taxonomic notes on North American *Salix*. *Madroño* **23**: 99.
- . 1976. A synopsis of American *Salix*. *Can. Jour. Bot.* **54**: 2769-2789.
- HOLMGREN, P. K., & W. KEUKEN. 1974. *Index herbariorum*. Part I. 6th ed. *Regnum Veg.* **92**: 1-397.
- SCHNEIDER, C. 1918. A conspectus of Mexican, West Indian, Central and South American species and varieties of *Salix*. *Bot. Gaz.* **65**: 1-41.
- . 1919a. Notes on American willows. III. A conspectus of American species and varieties of sections *Reticulatae*, *Herbaceae*, *Ovalifoliae*, and *Glaucae*. *Bot. Gaz.* **67**: 27-64.
- . 1919b. Notes on American willows. IV. Species and varieties of section *Longifoliae*. *Bot. Gaz.* **67**: 309-346.
- . 1920a. Notes on American willows. VII. *Jour. Arnold Arb.* **1**: 147-171.
- . 1920b. Notes on American willows. VIII. *Jour. Arnold Arb.* **1**: 211-232.
- . 1920c. Notes on American willows. X. *Jour. Arnold Arb.* **2**: 65-90.
- . 1921. Notes on American willows. XII. *Jour. Arnold Arb.* **3**: 61-125.

BOX 1471

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